Space Weather Technical Forecast

Issued on Friday, 29 September 2023 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-flares throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low activity with only occasional low level C-class flares observed. There are eight sunspot regions on the disc, the most complex is AR3450 in the southeast which has seen some small growth and complexification, but remains a relatively small region. AR3449 in the northeast has also seen the emergence of small trailer spots, however this region remains simpler. No Earth-directed CMEs have been observed in the past 24hrs.

Solar Wind / Geomagnetic Activity: A weak CME was observed arriving at 28/2039 UTC. Solar winds remained slightly elevated varying between 420-500km/s throughout with density below average. The interplanetary magnetic field (IMF), Bt, was initially weak, below 6nT, rising to Moderate at 28/2039 becoming 7-9 nT. The north-south component (Bz) was also initially weak, but become predominately negative and Moderate (southward) from 28/2330 UTC with a minimum -8nT. This was likely due to passage of a weak magnetic cloud associated with the CME. Phi angle was largely positive (away from the Sun), but briefly became negative 29/0400-0900 UTC. Resultant geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was initially at Moderate levels, but did briefly reach High levels at the peak of the diurnal cycle, reaching 1186 pfu at 28/1650 UTC. Flux then decreased to background from around 29/0400 UTC. Associated 24-hour fluence remained just below the Active (1e8 integrated pfu) threshold. The observation at 29/0000 UTC was 5.11e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to remain at Low to Moderate levels, with further isolated M-class flares possible.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Current slightly elevated solar winds, due to the overnight CME are expected to gradually ease day 1 (29 Sep). The next enhancement is anticipated on day 4, due to any fast wind enhancement from coronal hole 54. Mainly Quiet to Unsettled geomagnetic activity is expected until this enhancement, most likely day 4 (02 Oct). Activity is then expected to increase to be Unsettled to Active with a chance of G1 Minor Storms.

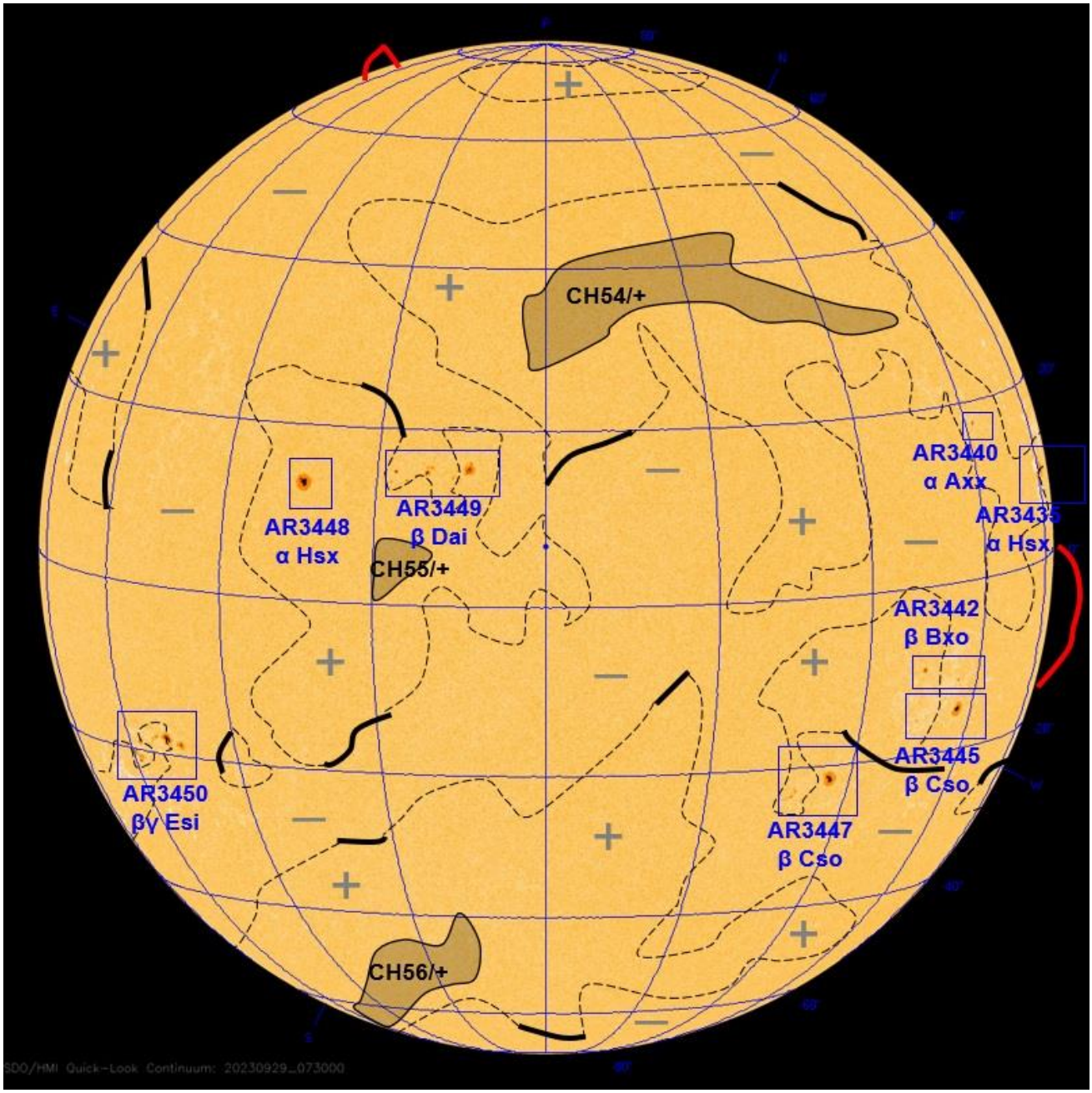
Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with a daily very slight chance of an enhancement should any larger flares occur.

High energy electron flux (greater than 2MeV) is expected to be Moderate, with diurnal peaks of High. The fluence is expected to remain below Active, but with a slight chance of rising above, mainly day 2 (30 Sep) onward. This is supported by REFM, which currently has a declining trend.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Figure 1. Solar Analysis Valid 29/0800 UTC.



.

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Geomagnetic Storms:

There are no Earth-directed CMEs.

Ongoing CME effects are being observed day 1 (29 Sep), however these are expected to soon ease with solar winds remaining slightly elevated to background, although likely declining. The main feature of this forecast period is the northern hemisphere coronal hole CH54+. This is a broad feature, but largely expected to not affect Earth, until later in the period due to a southwest extending lobe currently near centre disc. Due to its positive polarity, this is favoured for connection at this time of year, bringing a chance of solar winds increasing to around 500 km/s and some enhancement geomagnetic activity. This is in-line with the current MOSWOC enlil forecast.

Mainly Quiet to Unsettled geomagnetic activity is expected until this enhancement, most likely day 4 (02 Oct). Activity is then expected to increase to be Unsettled to Active with a chance of G1 Minor Storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	5	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Low to Moderate activity expected with a chance of isolated M-flares.

Of the eight sunspot regions currently on the disc, AR3450 is the most complex and has seen some slow growth during the past 24 hours, including the development of a beta-gamma magnetic structure. However this spot remains relatively small, with only low C-flares being observed. AR3449 saw the development of weak spots near its trailer region, however this spot remained simple and inactive. The other spots on the disc are currently stable or slowly declining.

Some magnetic looping is evident in imagery e.g. SDO/aia-171 on the northeast limb, perhaps associated with ex-3423. This may lead to a further sunspot region rotating onto the disc during the next 24 hours.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels, with the current sunspots on the disc considered unlikely to produce proton events.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) observed by GOES16 was initially Moderate on 28 Sep after recent CME enhancements, however dropped out due to the further weak CME which arrived overnight. Flux is now recovering to Moderate, perhaps briefly high values during diurnal maximum. These values are expected to persist until day 4 (02 Oct) when a further drop out is likely from the onset of any fast winds from coronal hole 54.

The fluence is expected to remain below Active, but with a slight chance of rising above, mainly day 2 (30 Sep) onward. This is supported by REFM, which currently has a declining trend.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	5	20	20	10
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2023. All Rights Reserved.